Bioelectric Characterization of T-cells With Electrochemical Impedance Spectroscopy

Valerie Pérez Medina, Marco Becerra Arias, Rubén Díaz Rivera
Department of Mechanical Engineering, University of Puerto Rico at Mayaguez

Significance

After transduction not all T-cells express CAR, resulting in a low quality and low potency therapy. By differentiating between T-cells and CAR-expressing T-cells, segregation can be done and could improve immunotherapy efficiency.

Hypothesis

[1]We hypothesize that the Electrochemical Impedance Spectroscopy (EIS) technique is sensitive enough to distinguish between CAR-expressing T-cells and T cells.

[2]We hypothesize that our system measurements varies with solute volume and microscope illumination intensity as controlled by the illumination knob; as suggested by literature.

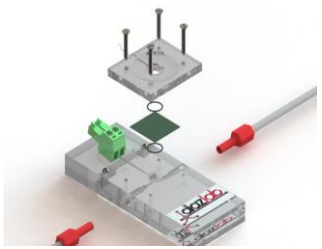
Objectives

[1] Analyze clustering formed in Principal Component Analysis from EIS data

[2] Obtain EIS plot when varying microscope illumination intensity and solute volume.

Methodology

EIS is performed in a microfluidic device using PBS as solute.



Three cell batches were analyzed:
TCELL: CD3+ T-cells
MIX: CAR Transduced T-cell
CARTMB: Magnetic Bead CAR T cells

Results

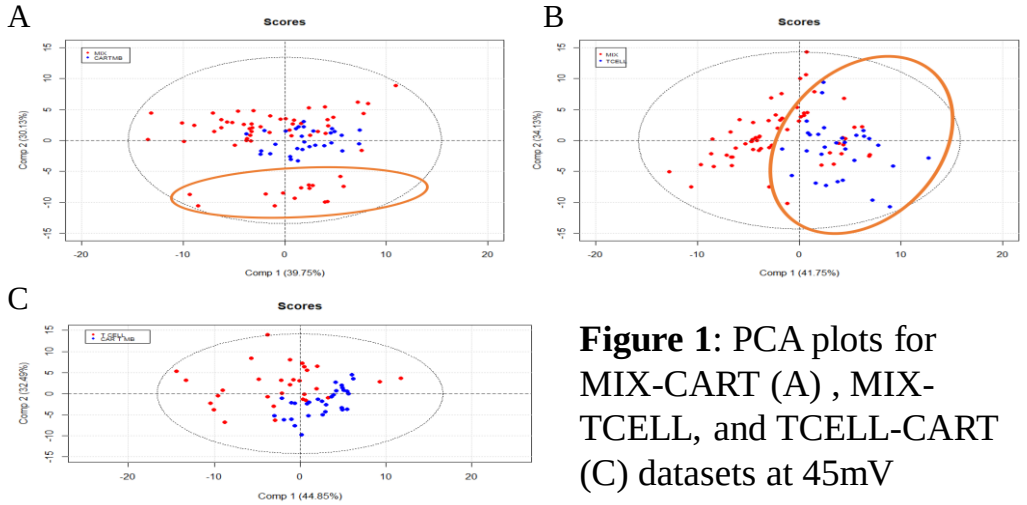


Figure 1: PCA plots for MIX-CART (A) , MIX-TCELL, and TCELL-CART (C) datasets at 45mV

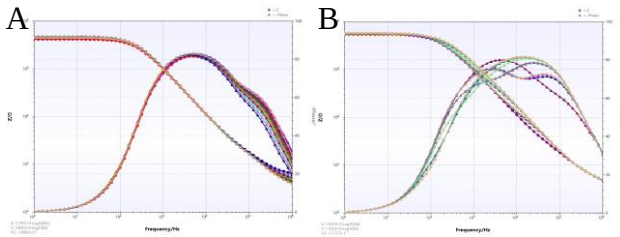


Figure 2 : EIS varies with solute volume (A) and microscope illumination intensity (B).

Discussion & Future Work

Figure 1: In A, circled red datapoints from MIX are segregated from the rest, including CARTMB. Whereas, in B the same circled data points from A are now integrated in the blue TCELL cluster. This suggest that those datapoints from MIX are T cells, while the others could be CAR T cells. In C, segregation between TCELL and CARTMB groups is observed.

Figure 2: Illumination affects EIS curves the most. Variations by experimental conditions should be considered during data analysis.

Future work will explore other machine learning techniques to differentiate between labeled and un-labeled datasets.

Acknowledgments: 5R25GM127191-04